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Two World Views on Carbon Revenues

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Abstract

The introduction of a price on carbon dioxide is expected to be more efficient than prescriptive regulation. It also instantiates substantial economic value. Initially programs allocated this value to incumbent firms (grandfathering), but the growing movement toward auctioning or emissions fees makes carbon revenues into a payment for environmental services. This paper asks, to whom should this payment accrue? If the atmosphere resource, as a common property resource, is viewed as the property of government, then the decision of how to use the revenue can be viewed as a fiscal problem, and efficiency considerations dominate. If the atmosphere is viewed as held in common, then the revenue might be considered compensation to owners and delivered as payment to individuals. This decision has efficiency and distributional consequences that affect the political economy and the likelihood and durability of climate policy. We summarize trends among six existing carbon-pricing programs.

Key Words: auction, cap and trade, emissions fee, emissions tax, allocation, grandfathering, climate change, policy

JEL Classification Numbers: H23, N5, P48

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1. Introduction

Most economic research suggests that the introduction of a price on carbon dioxide (CO_2) emissions—and, where possible, on other greenhouse gases—would be more efficient than prescriptive regulations as a way to mitigate global warming. A price can be introduced by establishing an emissions fee (tax), enforcing a cap on total emissions and introducing tradable emissions allowances, or developing tradable credit programs such as a tradable emissions rate performance standard. With the introduction of a price, a commodity value that yields associated revenue is realized.

This paper addresses how to assign the economic value that the introduction of a carbon price creates and frames the decision on the basis of property rights. If the atmosphere resource is viewed as the property of incumbent emitting firms, then the economic value should accrue to incumbents, such as through the grandfathering of emissions allowances, as done in the early emissions trading programs. A number of considerations have contributed to the decline in popularity of this type of approach, including the opportunity for changes in revenues far in excess of changes in costs. In other words, when grandfathering is applied to carbon pricing, incumbents have an opportunity to attain windfall profits.

With the move away from grandfathering to the introduction of a price through revenue-raising auctions for cap and trade or emissions fees, the "polluter pays" principle has become the fundamental design principle in incentive-based programs, and carbon revenues have come to constitute payment for environmental services. The central question we address in this paper is, to whom should this payment accrue?

A voluminous literature already exists on the potential disposition of revenue collected under a carbon emissions tax or the allocation of emissions allowances (including the possibility

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of a revenue-raising auction).[1] Most attention has been given to the question of efficiency, with some given to distributional outcomes. However, the philosophical underpinnings of the choice and its implied social ecology have rarely been discussed.

If atmospheric resources are viewed as the property of governments, then the decision of how to use the revenue can be viewed fundamentally as a fiscal problem, and efficiency considerations would likely be dominant. If the atmosphere is viewed as a common property resource, then the revenue might be viewed as compensation to owners of the resource and delivered as payment to individuals. This decision has efficiency and distributional consequences that affect the political economy, the likelihood and durability of climate policy, and the understanding of property rights and social relations.

The next section of the paper provides the conceptual background for assigning value from pricing carbon. Section 3 describes the evolution of thinking about the ownership rights of the atmosphere resource and the emergence of a framework where market-based approaches can be characterized as payment for environmental services. In section 4, we look at the experience of climate policies in raising revenue, and in section 5, we examine how revenue has been allocated heretofore under various policies. Section 6 offers a discussion and conclusion.

2. Background

With special assumptions such as zero transaction costs in a private good context, the external costs imposed by one party on another can be regulated to an efficient level simply through the introduction of property rights. Beyond issues of enforcement, the allocation of these rights and associated institutions would not matter to the efficiency of the outcome.

In contrast, the atmosphere is a depletable (rivalrous), nonexcludable public good, generally described as a common property resource, whose ownership is generally viewed to be held in common. A primary challenge in regulating a common property resource is coordination and enforcement of limitations on its use, invoking potentially substantial transaction costs. In this context, as Professor Ronald Coase explained in his Nobel Prize lecture (Coase 1992) the outcome will depend on the assignment of property rights, and institutions will matter importantly.

[1] An emissions rate trading program is emerging as a likely policy to regulate CO_2 under the Clean Air Act. The economic value created under this type of trading program remains within the regulated industry.

> If we move from a regime of zero transaction costs to one of positive transaction costs, what becomes immediately clear is the crucial importance of the legal system … what are traded on the market are not, as is often supposed by economists, physical entities but the rights to perform certain actions and the rights which individuals possess are established by the legal system.

A price on carbon imposes a regulatory constraint on access to the atmosphere resource. Historically, governments have often imposed a price for access to resources that were previously unpriced, such as timber or the airwave spectrum. In the context of climate policy, the allocation of resource value created by a price on carbon has emerged as central to the debate. Indeed, Ellerman (1999) suggests that "the biggest obstacle [to establishing a functioning national cap and trade system] is … deciding who gets the rent generated by limiting the right to emit CO_2." The unique aspect in the case of carbon pricing fundamentally may be one of scale. A national cap-and-trade program on CO_2 would constitute the largest creation of a federally enforced property right since the opening of the American West. And as with that historic experience, the decision with respect to rights to use the atmosphere will shape social relationships in the future.

The fundamental question of to whom this payment should accrue, we argue, hinges on whether one views the atmosphere resource as belonging to the state or to individuals (held in common).[2] From a practical perspective, if the resource is held by the state, then its management is part of the government's planning problem that balances revenues, short-run expenditures, and long-run capital (infrastructure) investments. Most of the literature on this topic has viewed climate policy in this context, with the assumption that the decision about how to assign revenue generated by a price on carbon is a fiscal problem for governments. Efficiency issues dominate the discussion about how to resolve this problem.[3]

One important reason that efficiency issues stem from the introduction of a price on carbon is that it raises the cost of energy and thereby reduces the real return to labor and capital. Preexisting taxes already create differences between the payments received by labor and capital and the payments by firms for these factors of production. The addition of a carbon price

[2] Such a question is reminiscent of another issue in environmental thought: willingess to pay versus willingness to accept, which also hinges on the assignment of property rights (Bromley 1995).

[3] Although individuals are harmed in different ways by the introduction of a price on carbon, and compensation can be a political necessity, if viewed as part of a larger fiscal problem where the efficiency criterion is consistently applied across the government's portfolio of policies, then the efficiency objective leads to economic growth that is expected to benefit all individuals (Polinsky 1972)

amplifies these differences, causing workers and owners of capital to reduce labor and investment, thereby reducing economic growth (Parry et al. 1999; Bovenberg and Goulder 2002). Before accounting for the revenues from pricing carbon, this hidden efficiency cost can be substantial. However, the hidden cost can be greatly reduced if the revenue from pricing carbon is used to offset preexisting taxes, described generally as a tax swap.[4] The consequence is that climate policy would be less costly in terms of its impact on economic growth. From this perspective, the fundamental question is often framed as how to *use* the economic value created from introducing a price on carbon.

Efficiency is a central consideration in the design of climate policy because emissions of greenhouse gases that contribute to global warming are ubiquitous in our economy. Mitigation of these emissions will be expensive. Doing so efficiently may be important to achieving overall climate goals.

The contrasting view is that the atmosphere resource is not the property of the state but is held in common by individuals. A carbon price constitutes payment for access to the resource—in other words, payment for environmental services. This view holds that the payment would flow as compensation to its owners; the government serves only as a trustee of the resource. This gives rise to the possibility of payments to individuals on a per capita (lump sum) basis, often referred as "climate dividends" in the policy debate (Barnes 2001; Barnes 2006). A third, intermediate category that we discuss below includes program-related expenditures that directly benefit energy consumers, with decisions remaining under government control. If the atmosphere resource is held in common by individuals, redirecting the payment away from the owners of the resource to any other use, including achievement of fiscal efficiency goals such as a tax swap, might constitute a regulatory taking. Capturing the economic value of the resource and directing it to the government's fiscal problem might seem comparable to confiscating the value of individuals' second homes for the same purpose. In other words, if one views the property right to atmosphere resources as inherently assigned to individuals and held in common, the issue of

[4] An important caveat is that the theory and computational models that have developed this policy guidance include the assumption of a fully employed economy and simplistic representations of labor force stratification and household labor and consumption decisions. In an underemployed economy, cash payments to households might be expected to have a stimulus effect, while the tax interaction effect may be unimportant (Burtraw and Parry 2011).

how to *use* the economic value created from introducing a price on carbon might be viewed as illegitimate, at least from the perspective of the resource owner.[5]

Advocates of per capita payments point to other characteristics as advantageous in the design of climate policy. First, per capita payments avoid the contentious role of government; they can be a transparent and simple system wherein government never has control of the revenues. James Hansen, the former head of the National Aeronautics and Space Administration's Goddard Institute for Space Studies, and Bill McKibben, author and leader of the climate policy advocacy group 350.org, both have advocated that a simple system could involve an emissions fee levied where fossil fuel enters the economy, with the revenues distributed as a dividend to every citizen (Hansen 2009; McKibben 2009).

A second characteristic is that per capita payments would have progressive impacts across the income distribution. Depending on whether these payments are taxable income and on the portion of revenue that is withheld to offset the impact on the government's preexisting budget requirements, a per capita payment can make roughly two-thirds of households strictly better off, including those with relatively lower income (Boyce and Riddle 2007; Burtraw et al. 2009).

Third, per capita payments may be politically reinforcing, potentially perceived as environmental justice, and the receipt of a payment may make climate policy popular for many voters (Barnes 2001; Boyce 2013). The costs of introducing a price on carbon will be obscured in the change of prices for goods and services throughout the economy; in contrast, the climate dividend is likely to be tangible.

In sum, the assignment of economic value from carbon pricing involves two considerations. The first is a philosophical view on who owns the atmosphere resource. The second is the efficacy of the overall design of carbon pricing for robust climate policy, which may involve a trade-off between efficiency and procedural fairness. Economic efficiency is important because greenhouse gases are ubiquitous in our economy, their mitigation will be expensive, and the political feasibility of doing so will depend on cost. An efficiency perspective advances climate policy by reducing its cost to the economy. In contrast, simple and transparent

[5] In reality, the government is the institution that we use to define and enforce property rights, whether they are assigned to the state, the church or other organizations, or individuals, As noted, it is not uncommon for government to reassign property rights to achieve a utilitarian outcome, but this can be problematic because the stability of property rights is important to their value in encouraging economic activity.

policy designs are viewed as fairer and less susceptible to manipulation. Mistrust of complicated institutions may erode public support for mitigating emissions; per capita payments might be perceived as fair.

These issues set the stage for a decision at the core of broad-based pricing of carbon emissions: the determination of property rights to the atmosphere resource.

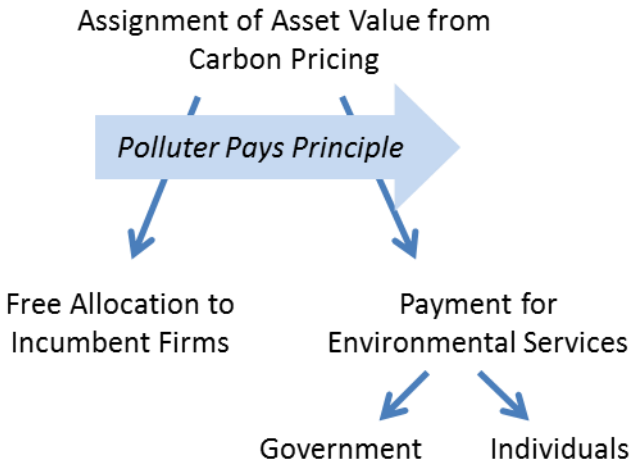
3. The Changing Paradigm

The approach to introducing a price on emissions and directing the economic value that is realized has evolved over time, beginning with allocation to incumbent emitting firms and moving increasingly toward other allocations that constitute payment for environmental services in one form or another. This trend is illustrated in Figure 1. Under "Payment for Environmental Services," we indicate two possible recipients: government or individuals. Equally relevant as who receives the value is who decides how it will be used. Contribution to general revenues and tax swaps are clearly the domain of government, while dividends are the domain of households. A third category is program-related expenditures, such as research and development or investments in energy efficiency. Decisions about these expenditures are made by government, not by households. However, the benefits are linked closely to the entities that are affected by the regulation and constitute a form of linked compensation, wherein the form of compensation directly addresses the form of harm.[6]

Identifying the atmosphere resource as state or common property does not lead to inherently different management institutions of the resource. As noted previously, with special assumptions such as zero transaction costs in a private good context the incentive to reduce pollution will be the same regardless of how the resource is managed or allocated. However, the distribution of that value among members of society and potentially on the environmental outcome of a carbon valuation policy is highly dependent on property regime. Because each property regime will lead to varied distributions of the carbon asset value, such as tax swaps or program-related expenditures, the resulting environmental outcomes are expected to be unique.

[6] Linked compensation enables subjective comparisons that are cognitively easier to make than comparisons between dissimilar effects, such as changes in energy prices and tax policy (Camerer and Kunreuther 1989). In psychology this is known as the compatibility hypothesis (Tversky and Thaler 1990).

Figure 1. Trend in Assignment of Asset Value to Payment for Environmental Services



In the economics literature, the traditional view motivating the introduction of a price on emissions was the expectation that doing so would improve cost-effectiveness over prescriptive regulation by equalizing marginal abatement costs among regulated sources. Introducing this concept required the political acceptance of the regulated community. Pezzey and Park (1998) writes that "existing regulated levels of emissions tend to be regarded as de facto rights, and will be defended by the interest groups which benefit from them." To accommodate this interest, early cap-and-trade proposals assigned the economic value of pricing emissions to incumbent emitters. This approach, known as grandfathering, could be expected to achieve a cost-effective outcome in the distribution of effort to reduce emissions in the short run and also is expected to lead to efficient investment and retirement in the long run from the industry through the internalization of externalities in the production decisions and in prices for consumers (Spulber 1985). The seminal market for sulfur dioxide created under the 1990 Clean Air Act Amendments allocated its allowances to incumbent emitters, except for 2.8 percent, which were withheld and sold in a revenue-neutral auction with the revenue returned proportionately to incumbent firms.

Although grandfathering promised a cost-effective outcome, it has important disadvantages. The distribution to the incumbent emitters of the economic value made fungible by the introduction of a price on emissions appears to reward emitters for past transgressions. The contradiction with the polluter pays principle is made more salient because grandfathering may result in windfall profits. This was not an important consideration in the sulfur dioxide

trading program because the industry was governed by cost-of-service regulation, so firms could not acquire windfall profits.[7] However, in the deregulated European electricity market at the outset of the Emissions Trading System (ETS) for CO_2, the presence of windfall profits was apparent. In 2006, after just one year of the program, Bundeskartellamt (the German Federal Cartel Office) criticized the practices adopted by the electricity companies.[8] These companies were effectively exhibiting competitive behavior by passing through in electricity prices the opportunity cost of emissions allowances they had received for free and that, if not used for power production, could be sold in the market. Various other formal investigations and academic studies concluded that the electricity industry earned windfall profits of billions of euros, meaning that the incumbent firms were grossly overcompensated by the practice of grandfathering.

Similar evidence is found in the US context. Bovenberg et al. (2005) find that profits can be maintained throughout the economy by freely allocating less (sometimes considerably less) than 50 percent of pollution permits, with the rest auctioned. Granting greater than this quantity for free would lead to windfall profits. In simulation modeling of the US electricity market, Burtraw and Palmer (2008) find that it would be sufficient to allocate just 6 percent of the allowances to the electricity industry to offset costs under a CO_2 trading program because a majority of costs are borne by consumers; allocation of greater than this amount would lead to windfall profits on average.

The leading alternative to grandfathering or other types of administrative allocation is auctioning. This achieved marquee status in the European telecom industry, "the biggest auction ever" (Binmore and Klemperer 2002). The first-ever revenue-raising auction for emissions allowances within a cap-and-trade program occurred in the state of Virginia in 2004 under the NO_x budget trading program among the northeastern states (Porter et al. 2009). Beginning in 2005, and through the first and second phases of the EU CO_2 Emissions Trading System, ceilings of 5 and 10 percent were placed on the portion of allowances that a member state could auction, and most member states chose to auction much less than the maximum. However, the EU moved to embrace auctions beginning in 2013, with the initiation of the third phase of its program.

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[7] Moreover, the size of the sulfur dioxide market was two orders of magnitude smaller than is the potential for a carbon market, meaning that windfall profits that might have accumulated after deregulation of the electricity industry were much smaller than could be expected in a carbon market.

[8] See the press release from December 20, 2006: http://www.bundeskartellamt.de/wEnglisch/News/Archiv/ArchivNews2006/2006_12_20.php.

During phase three (through 2020), auctions will account for the allocation of a majority of emissions allowances.[9] As we discuss below, auction revenue in the EU is directed to a variety of purposes, including investment in renewable energy development and the finance of climate action programs within the EU as well as in developing nations.[10]

The first cap-and-trade program to give an important role to a revenue-raising auction was the Regional Greenhouse Gas Initiative (RGGI) in the northeastern United States. Rather than place a maximum on the portion of allowances that could be auctioned, as occurred in the EU during phase 1 (5 percent) and phase 2 (10 percent) of its program, in RGGI the participating states were required to direct a minimum of 25 percent of the allowance value toward strategic energy investments, effectively requiring an auction of at least that size. The program began in 2009, with the first auction held in the fall of 2008. In practice, roughly 90 percent of the allowances have been auctioned, with exceptions of free allocation occurring on a case-by-case basis to address specific transitional burdens imposed by the interaction of the program with other preexisting regulatory decisions. The auction revenues have largely been directed to business and residential energy efficiency measures and low-income rate relief.[11]

The expanding role given to auctions was reflected in the design of the national Waxman-Markey legislation (HR 2454), which the US House of Representatives passed in 2009 but the Senate never passed. Importantly, that role would have expanded over time, as free allocation would have decreased.[12]

This trend is also reflected in the design of California's cap-and-trade program that began in 2013, with its first auction held in 2012. The California program is the first cap-and-trade program to direct a substantial portion of allowance revenue as a dividend, characterized explicitly as a payment for environmental services. The majority of allowances associated with emissions in the electricity sector are to be consigned to an auction, and the revenue is to be used for the benefit of ratepayers, with approximately 60 percent "given to residential customers as an

[9] In 2013, for the majority of member states, 100 percent of the allowances associated with the electricity sector will be auctioned; however, for eight member states, it will be 30 percent. For aviation, 15 percent of allowances will be auctioned, and for industry, 20 percent will be auctioned. The percentages that are auctioned increase over time. See http://www.cdcclimat.com/IMG//pdf/13-01-24_climate_brief_no25_-_auction_revenues_in_eu_ets_phase_3.pdf.

[10] At least 50 percent of EU revenues must go to combating climate change. See http://ec.europa.eu/clima/policies/ets/cap/auctioning/index_en.htm.

[11] http://www.rggi.org/docs/Documents/2011-Investment-Report.pdf.

[12] It is noteworthy that an important part of the free allocation would have accrued to electricity consumers through reductions in their electricity bills to offset the increase in energy costs associated with the trading program.

equal semi-annual bill credit for each residential account. This 'climate dividend' … will be paid by polluters for the right to emit greenhouse gases" (CPUC 2012). The dividends are managed by regulated electricity companies rather than government.

The other major way of introducing carbon pricing has been through emissions fees. Carbon taxes have been introduced in nine European countries, and France has recently positioned itself to become the tenth. Sometimes the tax affects industries that are also regulated under the cap-and-trade program. In those cases, no additional emissions reductions would be expected as a consequence of the tax, and the tax is effectively fiscal cushioning, enabling a tax swap and the reduction of taxes elsewhere in the economy.

One important carbon tax that compares directly to existing-cap-and trade programs is that of British Columbia, which adopted the tax in lieu of cap and trade. British Columbia is a member of the Western Climate Initiative (WCI), a collaborative of seven western US states and four Canadian provinces. A number of WCI participants decided not to adopt a price on carbon. California has adopted cap and trade, and British Columbia decided to introduce a tax. Another WCI member, Quebec, will initiate a cap-and-trade program and formally link with California in 2014. Revenues from the British Columbia tax are primarily directed toward the efficiency goal by enabling a tax swap. However, a portion of the revenues is used for direct payments to low-income households and a variety of other purposes.

4. Accumulating Experience in Payment for Environmental Services

We consider auctions (or taxes) that raise revenue to constitute payment for environmental services; we do not consider allowance or revenue allocation to emitters to be the same, because the right to emit is given away for free and does not constitute a payment by industry.[13] Over time, we observe that payments for environmental services have expanded steadily as a share of total asset value created under carbon pricing.

Table 1 reports the magnitude of the total asset value in six carbon-pricing programs in 2012 and the percentage of the asset value being collected as payment for environmental services.[14] Total asset value is defined as the value of emissions allowances distributed, valued at

[13] Consumers may see higher product prices, which is the source of potential windfall profits under free allocation.

[14] We do not include New Zealand, which initiated its cap-and-trade program in 2008. This program is excluded because no allowance auctions have been conducted as of July 2013. We also do not include existing carbon taxes in nine European nations, all of which also participate in the EU ETS.

the average annual price, or the value of tax revenue collected. In two programs, the carbon asset value can almost entirely be considered a payment for environmental services. In RGGI, firms purchase the large majority of allowances in an auction, and in British Columbia, asset value is realized through payment of a carbon tax; the entire revenue in each case is subsequently used for purposes that are consistent with payment for environmental services. California and the EU do not auction as great a percentage of their allowances, but the revenue that does accrue from allowance sales is used in ways that are consistent with payment for environmental services. Australia mandates that the firms covered under its policy pay a tax for each ton of carbon emitted. Approximately 40 percent of the revenue is returned to carbon-intensive firms to allay concerns about international competitiveness, which we do not consider as payments for environmental services. It should be noted that in order to meet emissions reduction targets, carbon prices are expected to rise, causing carbon asset values to grow in future years.

Table 1. Total Carbon Asset Value and Percentage Viewed as Payment for Environmental Services (2012)

	Allowance price or tax (2012 US$)	Total asset value (millions 2012 US$)	Payment for environmental services as percentage of total
RGGI	1.93	186	90
California	12.95	812	47
British Columbia	30.00	1,075	100
European Union*	5.82	16,124	5
Alberta	15.00	Undefined	Undefined
Australia	23.00	7,121	61

* The estimates for the EU include only the Emissions Trading System and exclude carbon taxes.
Notes: The average 2012 allowance price is used when multiple prices occur in one year. Asset value for RGGI calculated with the assumption that 2012 auction value is 90 percent of total asset value. Alberta's total carbon asset value includes value generated from offsets and emissions performance credits, but the only documented value is that which is collected by the provincial government directed toward the climate change and emissions management corporation. Sources are provided after the list of references.

The trend among carbon-pricing programs has been toward assigning carbon asset value as a payment for environmental services and away from allocating revenue or free allowances to industry. The trend in six carbon-pricing programs between 2008 and 2013 is illustrated in Figure 2. Exclusion of carbon taxes in Europe that generally contribute to government revenues

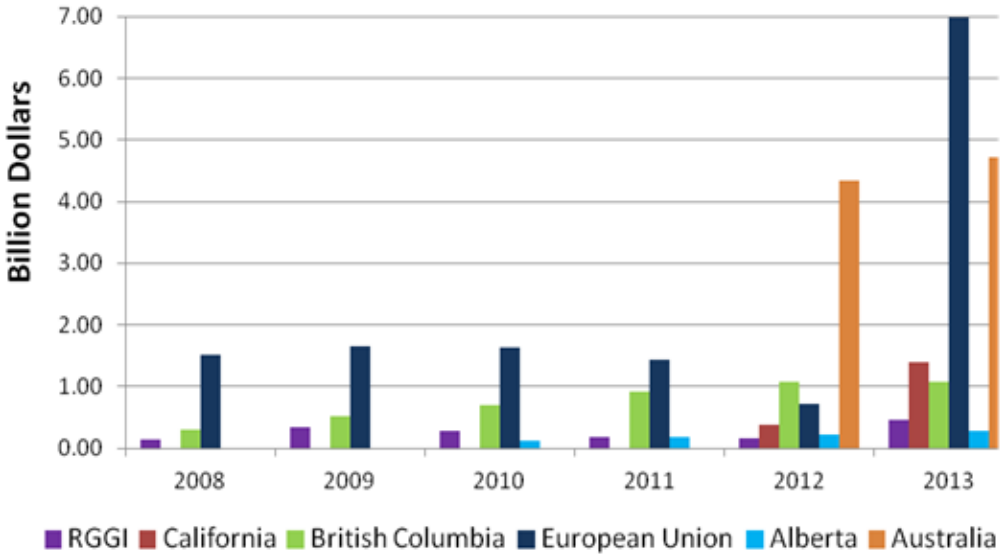
understates the growing trend. We assume the entire value of auctioned allowances in the EU is utilized as payments for environmental services, following evidence for Germany—the largest auctioneer of EU allowances—which invested the totality of its revenue on payments for environmental services in 2012.[15] Because of the magnitude of emissions covered, the EU generated the most revenue as a payment for environmental service in every year except 2012, when the price of emissions allowances and their associated market value fell sharply. EU revenues increase more than threefold in 2013 as a result of the greater volume of allowances required to be auctioned beginning in phase 3 of the EU ETS. Although New Zealand has not been included in this analysis, it has recently passed a bill that gives the government the power to auction allowances, further indicating a trend away from free allocation.[16]

After normalizing for the size of the program on a per capita basis, British Columbia achieves the greatest payment for environmental service revenues among the six programs, as illustrated in Figure 3, with a value of over $200 per person per year. Australia's program is of comparable magnitude. The EU program is also substantial in this measure. In California, the per capita value will grow multifold when transportation fuels enter the market in 2015.

[15] https://germanwatch.org/en/download/7749.pdf.

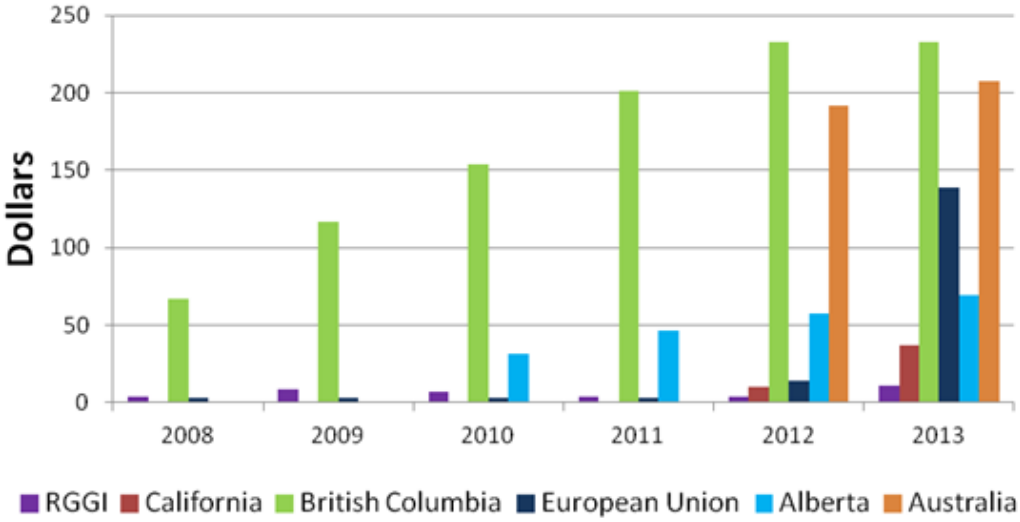
[16] http://www.climatechange.govt.nz/emissions-trading-scheme/ets-amendments/.

Figure 2. Value of Payments for Environmental Services (a Portion of Total Asset Value) (in current-year US$)



Notes: Where annual revenues were not provided by regional budget estimates, they were calculated by multiplying average annual allowance price by quantity of allowances auctioned. A single August 2013 exchange rate was used to convert all current-year values to dollars. Sources are provided after the list of references.

Figure 3. Value of Payments for Environmental Services per Capita (current-year US$/person)



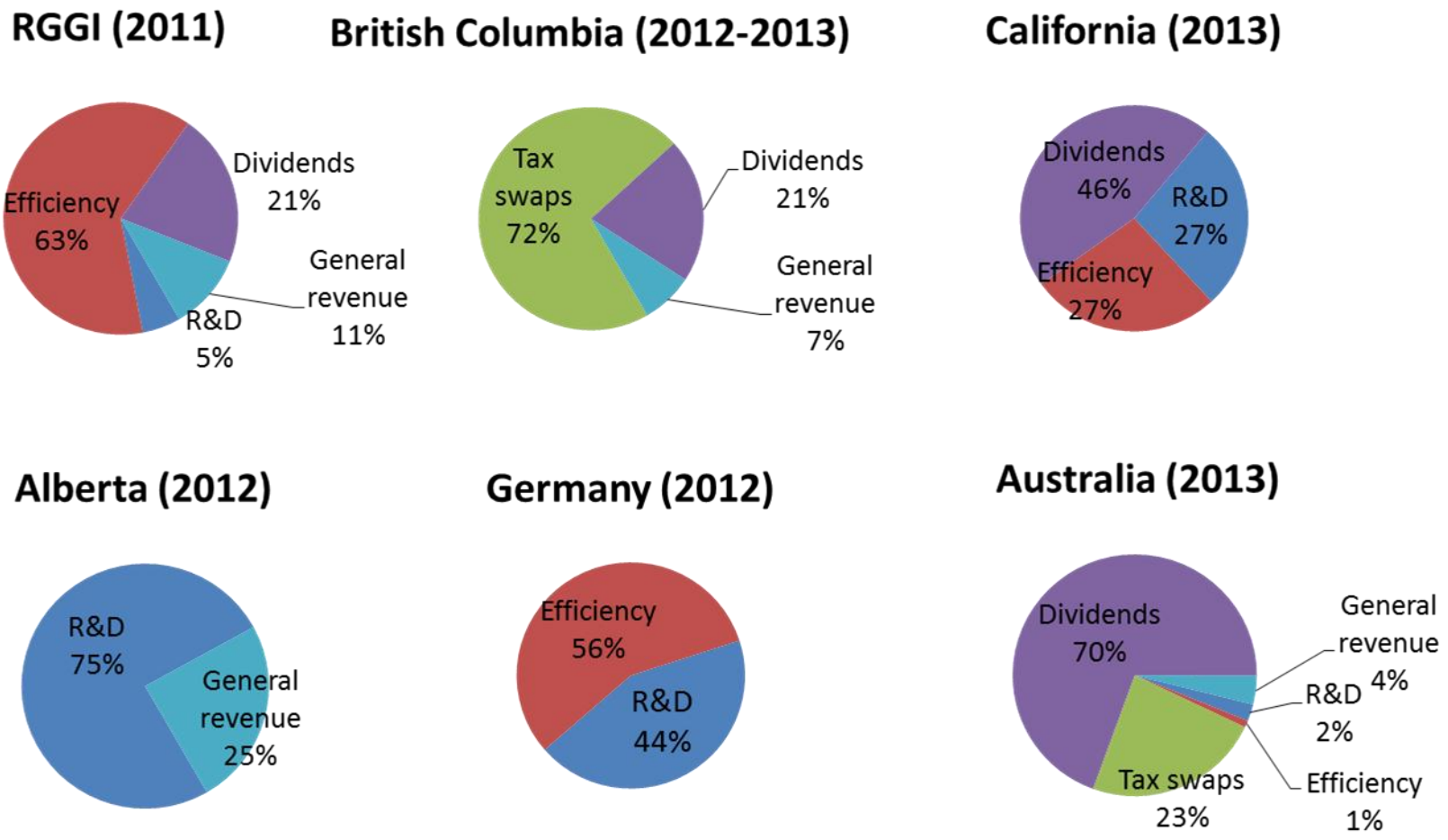
Notes: Populations for 2013 are assumed equal to 2012 for all regions except Alberta, for which official 2013 population data are used; 27 countries were included in EU's population estimate. A single August 2013 exchange rate was used to convert all current-year values to dollars. Sources appear after the list of references.

5. How Funds Are Used

Within the general classification of payment for environmental services, we have identified five categories of revenue spending. Revenue can be directly returned to households through dividends or the implementation of energy efficiency. Alternatively, revenue can be considered as state general revenue, used for tax swaps, or earmarked for research and development (R&D). R&D earmarks, including those returned to an industry covered by a carbon-pricing program, are included as a payment for environmental service only when the R&D investment is not proportional to emissions generated by a firm or sector.

Figure 4 illustrates the proportion of revenues invested in these five categories under each carbon-pricing program. The EU ETS spending is represented by Germany, which auctioned a relatively large share of its allowances in 2012 compared with other EU member states. Investment in program-related energy efficiency and investment in renewable energy projects—efficiency and R&D—are the most common forms among the six programs, accounting for more than half of all revenue spending in RGGI, California, Germany, and Alberta. A direct per capita payment in the form of a dividend also accounts for more than one-fifth of revenue spending in RGGI, California, British Columbia, and Australia. The jurisdictions that employ a carbon tax, British Columbia and Australia, have used the revenue to offset other taxes or make direct dividend payments to target a subset of the population, such as low-income households, as beneficiaries of the carbon tax. See the appendix for descriptions of each region's payments for environmental services.

Figure 4. Use of Revenues from Payments for Environmental Services



6. Conclusion

The existing programs that introduce a price on carbon emissions exhibit a trend away from free allocation of emissions allowances to incumbent firms toward the polluter pays principle. The fundamental question we address is, to whom should payments for utilization of the atmosphere resource accrue? The first element we consider is philosophical: if the atmosphere is considered to be property of the state, then rents from the use of that property can be utilized at the government's discretion in addressing its fiscal problem. Alternatively, if the atmosphere is thought to be owned by individuals in common, those individuals have a claim to the payments for environmental services, which can be viewed as compensation, implying that the use of atmosphere resource rents to address the fiscal problem is invalid.

A second element of the question is practically relevant to the prospect of successful long-run climate policy. Is the primary consideration in deciding how to use carbon-pricing revenue one of efficiency or policy process? It is widely understood that efficiency—that is, economic growth—is enhanced if revenues from the introduction of the price on carbon are used to reduce preexisting taxes. Greenhouse gases are ubiquitous in our economy, and their mitigation will be expensive. Reducing the economic cost of mitigation is of practical importance to its political acceptability. However, amid skepticism toward complex government institutions and markets, returning the value of a common property resource to individuals in the form of dividends might be viewed as more legitimate and transparent, and perhaps more politically feasible.

When defining the atmosphere as a common property resource, it can be argued that the owners of the resource are not only individuals within certain national or regional borders but all individuals, to whom the atmosphere resource belongs globally. Therefore, suggesting the primacy of efficiency goals versus per capita payments has international implications. From a global perspective, per capita payment for environmental services implies a substantial transfer of wealth to the developing world as part of the cost of mitigating climate change. Although this argument may be philosophically valid, property rights can be secured only within a common legal framework. Thus, in the absence of an international agreement securing each nation's rights to the atmosphere, it is unreasonable to expect the property rights of nations outside the borders of a carbon-pricing regime to be recognized.

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Figures 2 and 4

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Figure 3 (see Figure 2 references for complete list)

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Appendix. Description of Expenditure Categories

	R&D	Efficiency	Tax swaps	Dividends	General revenue
Alberta	Research in oil and gas extraction; nonconventional oil extraction; natural gas distribution; electric power generation				Water and sewage systems; transportation and warehousing; municipal governments; chemical manufacturing; agriculture, forestry, and food service; adaptation projects
Australia	Carbon farming initiatives	Low-carbon communities program; household energy efficiency	Tax reform	Low- and middle-income household assistance and transfer payments	Biodiversity fund; natural resources management planning; governance
British Columbia			Income tax cut; corporate income tax cut; small business tax cut	Rural homeowners' benefit; low-income tax credit; industry property tax credit	School property tax reform; tax credits: seniors' home renovation; children's fitness/arts; small-business venture; digital media
California	Low-carbon transport and infrastructure; clean energy development	Energy efficiency implementation; solid waste diversion			

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	R&D	**Efficiency**	**Tax swaps**	**Dividends**	**General revenue**
Germany (proxy for the entire ETS)	Renewable energy development; electromobility	National and international climate action programs; energy efficiency implementation; CO_2 building restoration and energetic urban renewal			
RGGI	Clean technology development	Residential and business efficiency and clean energy implementation		Low-income assistance; general rate relief	Municipal, state, and community